

## CLAIMS

1. A communication device, which uses turbo codes as error-correction codes, comprising:

a turbo encoder which carries out a turbo encoding  
5 process on lower two bits in transmission data to output an information bit list of the two bits, a first redundant bit list generated in a first convolutional encoder having the information bit list of the two bits as an input and a second redundant bit list generated in a second  
10 convolutional encoder to which the respective information bit lists that have been subjected to interleave processes are switched and input;

a first decoder unit which extracts the information bit list of the two bits and the first redundant bit list  
15 from a received signal, and calculates the probability information of estimated information bits by using the results of the extraction and probability information that has been given as preliminary information;

a second decoder unit which extracts the information  
20 bit list of the two bits and the second redundant bit list, and again calculates the probability information of estimated information bits by using the results of the extraction and the probability information from the first decoder unit to inform the first decoder unit of the results  
25 as the preliminary information;

a first estimating unit which, based upon the results of the calculation processes of probability information by the first and second decoder units that are repeatedly executed, estimates the information bit list of the original  
5 lower two bits for each of the calculation processes;

an error correction unit which carries out an error checking process on the estimated information bit list by using an error correction code, and terminates the repeating process at the time when a judgment shows that the estimation  
10 precision exceeds a predetermined reference, as well as simultaneously carrying out an error-correction process on the estimated information bit list of the original lower two bits by using an error correction code; and

a second estimating unit which hard-judges the other  
15 upper bits in the received signal so as to estimate an information bit list of the original upper bits.

2. The communication device according to claim 1, wherein the error correction unit carries out an error checking  
20 process each time the information bit list of the lower two bits is estimated, and terminates the repeating process at the time when a judgment shows that "no error exists" in the estimated information bit list.

3. The communication device according to claim 1, wherein the error correction unit carries out an error checking process each time the information bit list of the lower two bits is estimated, and terminates the repeating process at the time when a judgment shows that "neither the information bit list estimated based upon the probability information from the first decoding unit nor the information bit list estimated based upon the probability information from the second decoding unit includes any error" in the estimated information bit list.

4. The communication device according to claim 1, wherein the error correction unit carries out the repeating process for a predetermined number of times, and after the bit error rate has been reduced, an error-correction process is carried out on the estimated information bit list of the original lower two bits by using error correction codes.

5. A communication device, which serves as a receiver using turbo codes as error-correction codes, comprising:  
a first decoder unit which extracts an information bit list of the two bits and a first redundant bit list from a received signal, and calculates the probability information of estimated information bits by using the results of the extraction and probability information that

has been given as preliminary information (in some cases, not given);

a second decoder unit which extracts the information bit list of the two bits and a second redundant bit list,  
5 and again calculates the probability information of estimated information bits by using the results of the extraction and the probability information from the first decoder unit to inform the first decoder unit of the results as the preliminary information;

10 a first estimating unit which, based upon the results of the calculation processes of probability information by the first and second decoder unit that are repeatedly executed, estimates the information bit list of the original lower two bits for each of the calculation processes;

15 an error correction unit which carries out an error checking process on the estimated information bit list by using an error correction code, and terminates the repeating process at the time when a judgment shows that the estimation precision exceeds a predetermined reference, as well as  
20 simultaneously carrying out an error-correction process on the estimated information bit list of the original lower two bits by using an error correction code; and

a second estimating unit which hard-judges the other upper bits in the received signal so as to estimate an  
25 information bit list of the original upper bits.

6. The communication device according to claim 5, wherein the error correction unit carries out an error checking process each time the information bit list of the lower two bits is estimated, and terminates the repeating process at 5 the time when a judgment shows that "no error exists" in the estimated information bit list.

7. The communication device according to claim 5, wherein the error correction unit carries out an error checking 10 process each time the information bit list of the lower two bits is estimated, and terminates the repeating process at the time when a judgment shows that "neither the information bit list estimated based upon the probability information from the first decoding unit nor the information bit list 15 estimated based upon the probability information from the second decoding unit includes any error" in the estimated information bit list.

8. The communication device according to claim 5, wherein 20 the error correction unit carries out the repeating process for a predetermined number of times, and after the bit error rate has been reduced, an error-correction process is carried out on the estimated information bit list of the original lower two bits by using error correction codes.

9. A communication device, which serves as a receiver using the turbo codes as error-correction codes, comprising:

a turbo encoder which carries out a turbo encoding process on lower two bits in transmission data to output  
5 an information bit list of the two bits, a first redundant bit list generated in a first convolutional encoder having the information bit list of the two bits as an input and a second redundant bit list generated in a second convolutional encoder to which the respective information  
10 bit lists that have been subjected to interleave processes are switched and input.

10. A communication method, which uses turbo codes as error-correction codes, comprising:

15 a turbo encoding step of carrying out a turbo encoding process on lower two bits in transmission data to output an information bit list of the two bits, a first redundant bit list generated in a first convolutional encoder having the information bit list of the two bits as an input and  
20 a second redundant bit list generated in a second convolutional encoder to which the respective information bit lists that have been subjected to interleave processes are switched and input;

a first decoding step of extracting the information  
25 bit list of the two bits and the first redundant bit list

from a received signal, as well as calculating the probability information of estimated information bits by using the results of the extraction and probability information that has been given as preliminary information  
5 (in some cases, not given);

a second decoding step of further extracting the information bit list of the two bits and the second redundant bit list, as well as again calculating the probability information of estimated information bits by using the results of the extraction and the probability information  
10 from the first decoding step to inform the first decoding step of the results as the preliminary information;

a first estimating step of estimating the information bit list of the original lower two bits for each of the calculation processes, based upon the results of the calculation processes of probability information by the  
15 first and second decoding steps that are repeatedly executed;

an error-correction step of carrying out an error checking process on the estimated information bit list by using an error correction code, and terminating the repeating  
20 process at the time when a judgment shows that the estimation precision exceeds a predetermined reference, as well as simultaneously carrying out an error-correction process on the estimated information bit list of the original lower  
25 two bits by using an error correction code; and

a second estimating step of hard-judging the other upper bits in the received signal so as to estimate an information bit list of the original upper bits.

5 11. The communication method according to claim 10, herein the error correction step carries out an error checking process each time the information bit list of the lower two bits is estimated, and also terminates the repeating process at the time when a judgment shows that "no error exists"  
10 in the estimated information bit list.

12. The communication method according to claim 10, wherein the error correction step carries out an error checking process each time the information bit list of the  
15 lower two bits is estimated, and terminates the repeating process at the time when a judgment shows that "neither the information bit list estimated based upon the probability information from the first decoding step nor the information bit list estimated based upon the probability information  
20 from the second decoding step includes any error" in the estimated information bit list.

13. The communication method according to claim 10, wherein the error correction step carries out the repeating  
25 process for a predetermined number of times, and after the



bit error rate has been reduced, an error-correction process is carried out on the estimated information bit list of the original lower two bits by using error correction codes.